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(54) MULTI-PANE ANTI-BANDIT GLAZING UNIT

(71) We, B F G GLASSGROUP, a French body corporate, of 43 Rue Caumartin, F-75009 Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a multi-pane glazing unit, having a first pane and a laminated safety pane which is disposed at a distance behind the first pane and comprises a plurality of individual panes glued together by plastics laminating films.

Multi-pane anti-bandit glazing units of the kind specified, more particularly bullet-proof double glazing units, in which the first pane is a pane of silicate glass disposed on the outside, form part of the prior art. It has been known for a long time that bullet-proof glazing can be obtained by using a pane armoured glass consisting of a number of glass panes glued to one another. It has been found that armoured glass of this kind with a thickness of 25 to 30 mm is secure against bullets from pistols and revolvers and such a pane having a thickness of 54 to 60 mm is secure against bullets from rifles, shot guns and the like. One disadvantage of the prior art glazing units is that they are relatively heavy due to the required thickness. Attempts have therefore already been made to substitute plastics for glass in such armoured glazing units, but it has been found that the advantage of plastics glazing units, i.e. that they are lighter than silicate glass armoured glazing units, is more than cancelled out by the disadvantage of the risk that their surfaces may get scratched, thus considerably limiting their utility, more particularly when used for outside glazing.

Due to the different coefficients of expansion of glass and plastics it has hitherto not been possible to combine successfully relatively thick panes of glass and plastics to form armoured glazing units in which the glass panes are on the outside, since in these conditions the necessary durability and utility, more particularly when subjected to solar radiation, as is unavoidable with outside glazing, are simply not present.

It is an object of the invention to provide a multi-pane anti-bandit glazing unit of the kind specified which has a discouraging effect on burglary and is secure against bullets from revolvers and pistols and also from rifles, shot guns and the like, can be manufactured at a relatively low cost and is suitable for use as an outside glazing, more particularly affording the possibility of using frame sections of conventional construction and if necessary providing heat-reflecting coatings or the like.

According to the invention there is provided a multi-pane anti-bandit glazing unit, having a first glass pane and a laminated safety pane which is substantially parallel with the first pane and is spaced therefrom in a direction perpendicular to said panes, the laminated safety pane comprising a plurality of individual glass panes adhesively bonded together by plastics laminating films and in which the first pane is 6 to 20 mm thick; the distance between the laminated safety pane and the first pane being at least two-thirds of the thickness of the first pane; the individual glass pane of the laminated safety pane nearest the first pane having a thickness of at least 5 mm, the thickness of successive individual glass panes of the laminated safety pane being progressively less in the direction away from the first pane and the thickness of at least one of the laminating films of the laminated safety pane being at least 1 mm.

In one particularly advantageous embodiment of the invention in which the laminated safety pane has at least three individual panes, the thicknesses of the individual laminated foils increases progressively in the direction away from the first pane i.e., in the direction of the area in which persons are in danger. The safety glass pane is therefore constructed asymmetrically in two respects, since the thickness of the individual panes decreases in the direction away from the first pane, while the thickness of the laminating films increases. It has been surprisingly found that the result is very high resistance to the penetration

of bullets.

It is very surprising that by the use of the bullet-proof double glazing unit embodying the invention and in which a monolithic thick sheet of glass is disposed on the outside, excellent protection can successfully be achieved against bullets from both pistols and rifles; moreover, as comprehensive shooting tests have shown, the adaption of the thickness of the first pane and correspondingly of the gap between the first pane and the laminated safety pane can reduce the energy of impingment of the projectile to such an extent that the laminated safety pane disposed behind can absorb such energy without itself being penetrated. It is particularly important that the bullet-proof glazing unit according to the invention is made up of elements which have proved satisfactory for glazing purposes for decades. With a much lower weight than that of armoured blocks of conventional kind, the double glazing unit according to the invention enables identical or even improved bullet-proof properties to be achieved. The pane costs little to manufacture, while the thickness hardly differs from that of conventional double glazing units, so that the pane can easily be used for outside glazing. It is advantageous that a heat-reflecting coating of conventional kind can easily be placed on the inside of a monolithic outer or first pane, so that the glazing unit according to the invention acts as a conventional insulating glazing unit.

Since, when receiving a hail of bullets or a large number of shots, a monolithic outside pane tends to collapse under unfavourable conditions and therefore can no longer fully perform the function of reducing the energy of impingement of the bullet on the laminated safety glass pane by transferring energy to a conical piece of glass broken out which then impinges on the laminated safety glass pane, a preferred embodiment of the invention incorporates features by means of which the bullet-proof properties are further improved against a hail of bullets or a continuous burst of firing. This preferred multiglazing unit, which is more resistant to a hail of bullets than the embodiments hitherto discussed, includes a plastics film disposed on the side of the outer or first pane remote from the laminated safety pane. Preferably, disposed on the outer surface of this plastics film is a retaining pane which has a thickness of not more than 4 mm.

It has been found that with this embodiment, in which a very thin retaining pane, connected to the outer pane after the fashion of a laminated safety pane, is disposed on the outer surface of the monolithic outer pane adjacent the side from which the bullet comes, the breaking-out from the first pane of a conical piece of glass by a bullet and vaporising of the bullet and atomization of the glass cone broken out of the monolithic first pane are maintained, while at the same time the retaining pane disposed on the side receiving the bullet has the effect of preventing any collapse of the first pane on the arrival of the first or one of the first of a hail of bullets. The outer pane remains completely effective, therefore, even under a burst of fire or any generally large number of projectiles.

In accordance with the inventive idea covered by the claims the invention of course also comprises within its scope a multi-pane anti-bandit glazing unit, in which both said first pane and said safety pane each have an asymmetrical laminated structure – i.e., with a thickness of the individual panes which decreases from the gap between the panes and an increasing thickness of the plastic laminating films. More particularly both arrangements of panes can be laminated safety glass panes each consisting of two silicate glass panes of differing thickness which are interconnected by a thick plastics laminating film. Embodiments of the invention are described below with reference to the diagrammatic drawings, wherein:—

Figure 1 is a section perpendicularly to the plane of the pane through an embodiment of a bullet-proof double glazing unit according to the invention;

Figures 2–5 show the behaviour of the bullet-proof double glazing unit illustrated in Figure 1 when it receives a shock from a bullet or gun, in successive stages;

Figure 6 shows a second embodiment of a bullet-proof double glazing unit according to the invention;

Figure 7 is a section through a third embodiment of a bullet-proof double glazing unit according to the invention, and

Figure 8 shows in section a fourth embodiment of a burglary-discouraging multi-pane unit according to the invention.

As shown by the drawings, a double glazing unit according to the invention illustrated in Figures 1 - 5 has an outer pane 10 which is disposed on the side liable to receive the bullet and takes the form of a monolithic silicate glass pane with a thickness of 8–20 mm. Adjoining the outer pane 10 on the side remote from the side from which the bullet is liable to come (always from the left in Figures 1 – 6) is a gap 12 between the panes whose thickness perpendicularly to the plane of the pane - i.e., measured in the plane of Figures 1 – 6 is at least two-thirds of the thickness of the outer pane 10, preferably equal to the thickness thereof. Adjoining the gap 12 between the panes is a laminated safety pane 14; of course the outer pane 10 and the laminated safety pane 14 can be interconnected at the pane edge by means of a suitable edge section or the like in manner conventional in double glazing units. In the embodiment illustrated in Figures 1 5 the laminated safety pane 14 consists of three individual

silicate glass panes, of which the inner pane 16 remote from the direction in which a bullet would come has a thickness of 3 mm, the central individual pane 18 has a thickness of 4 mm, and the individual pane 20 adjacent the gap 12 between the panes has a thickness of 5 mm. Individual pane 20 is glued to the central individual pane 18 by a laminating sheet 22 of polyvinylbutyral whose thickness in the embodiment illustrated is 0.76 mm, while the laminating film 24 connecting the inner pane 16 to the central individual pane 18 has a thickness of 1.14 mm.

In one variant of the embodiment described above with reference to Figure 1, the pane 20 has a thickness of 6 mm instead of 5 mm, the other dimensions being the same as described above with reference to Figure 1.

Two other variants differ from that described with reference to Figure 1 only in that the pane 16 has a thickness of 2 mm and the pane 20 a thickness of 10 mm, in the case of one such variant and in that the pane 16 has a thickness of 2 mm and the pane 20 a thickness of 8 mm in the case of the other embodiment.

In a further variant, not shown, the laminated safety pane has, in succession in the direction away from the first pane (corresponding to pane 10 in Figure 1), a silicate glass pane which is from 10 to 12 mm in thickness, a laminating film which is 0.38 mm in thickness, a silicate glass pane which is 6 mm in thickness, a laminating film, which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness and a silicate glass pane which is 2 mm in thickness.

One characteristic of the aforedescribed double glazing unit is that the laminated safety pane 14 is at a distance from the outer pane 10 which is preferably substantially equal to the thickness of the outer pane 10, and is at least equal to two-thirds of the thickness thereof, another feature being that the laminated safety pane 14 is asymmetrically constructed, the thickness of the individual panes 20, 18, 16 of the laminated safety pane decreasing from the gap 12 between the panes in the direction of the pane surface remote from the direction from which a bullet might come, while the thickness of the laminating films 22, 24 increases in the same direction.

Of course, the individual panes 16, 18 of the laminated safety pane 14 can be replaced by plastics panes of known kind, but the individual pane 20 should be a silicate glass pane having a thickness of at least 5 mm. It has been found that in this case if necessary the thickness of all but one of the laminating films of the laminated safety pane can be reduced below 1 mm. If the panes 16, 18, 20 are all made of silicate glass, as in the embodiment illustrated in Figures 1 5, the panes 16, 18, or if necessary merely the pane 16, can consist of chemically prestressed glass. However the pane 20 should not be made of prestressed glass.

The embodiment of the bullet-proof double glazing unit according to the invention illustrated in Figure 6 differs from that illustrated in Figures 1 – 5 in a number of ways. Thus, in the embodiment of Figure 6, a heat-reflecting coating 26 is disposed on that inner surface of the monolithic silicate glass outer pane 10 which is adjacent the gap 12 between the panes 10 and 14. If necessary, this inner surface can support, as well as the heat-reflecting coating 26, an alarm device in the form of alarm wires or the like, so that if a shot is fired at the glazing an alarm is automatically and reliably set off. In addition to the possibility of providing a heat-reflecting coating, the outer pane 10 can also be made of fire-resistant glass.

In the embodiment illustrated in Figure 6 moreover the laminated safety pane 14 has only two individual panes 20, 16, of which the individual pane 20 adjacent the gap 12 between the panes has a thickness of 5 mm and the individual pane 16, connected to the individual pane 20 by a laminating film 24 having a thickness of 1.14 mm, has a thickness of 3 mm. Disposed at a distance from the laminated safety pane 14 on the side remote from the direction in which a bullet might come, and separated from pane 14 by a further air gap 28, is a splinter-catching pane 30 consisting of two individual panes 32, 34 of silicate glass each having a thickness of 3 mm, which are glued to one another by a polyvinylbutyral film 36 having a thickness of 0.38 mm. At least the individual pane 34 of the splinter-catching pane 30 adjacent the inner space covered by the bullet-proof double glass pane advantageously consists of chemically prestressed glass. The thickness of the gap 28 between the panes 14 and 30 is so selected that the laminated safety pane 14 is not prevented from bulging freely if it receives a projectile in a manner explained below with reference to Figures 2 to 5.

The manner in which the double glazing units shown in Figures 1 and 6 operate is illustrated in Figures 2 to 5:

Figure 2 shows on the left-hand side a projectile 38 fired from a revolver or rifle flying towards the outer pane 10. The projectile 38 then impinges on the thick, monolithic silicate glass outer pane 10 over an impingement area corresponding to the diameter of the projectile, so that its whole kinetic energy comes into effect. As a result, as shown diagrammatically in Figure 3, a conical piece of glass 40 is broken out of the outer pane 10, is thrown across the gap 12 and then impinges on the individual pane 20 of the laminated safety pane 14, the surface over which the piece of glass 40 impinges on the individual

pane 20 being substantially larger than the impingement area of the projectile 38 on the outer pane 10, so that the loading per unit of surface area on the laminated safety pane 14, compared with the loading of the outer pane 10 by the projectile 38, is considerably reduced. For instance, the impingement surface on the outer pane 10 is 45.6 mm² using a rifle projectile having a calibre of 7.62 mm (NATO rifle), while the surface directly affected on the laminated safety pane 14 is 10381 mm², corresponding to a measured diameter of 115 mm, the result being an enlargement by 228 times of the surface stressed. The size of the surface stressed on the laminated safety pane 14 can be varied by changing the thickness of the outer pane 10 and of the gap 12 between the panes, in dependence on the required degree of security and the type of projectile to be expected.

In the manner shown in Figure 4 the conical piece of glass 40 knocked out of the outside pane 10 by the projectiles 38 is very largely ground up into glass dust and disintegrated on the individual pane 20 of the laminated safety pane 14. At the same time the projectile is broken up into its individual components, as shown in Figure 4, the lead, of which the projectile is usually at least partly made, being partly vaporised.

The further reduction of the energy of the projectile can be seen from comparing Figures 4 and 5, which show that the laminated safety glass pane 14 arches in the direction of the inner space covered by the bullet-proof double glass pane, accompanied by further disintegration of the individual pane 20 adjacent the gap 12 between the panes. As shown in Figure 5, the remains of the projectile and the glass dust resulting from the crushing of the conical piece of glass 40 and the corresponding zone of the individual pane collect adjacent the lower frame section 15.

It should be noted that in the embodiment illustrated in Figures 1 - 5 the outer pane 10, can have a thickness of, for instance, 6, 8, 10, 12, or 20 mm, in dependence on the required degree of safety and the projectile to be expected. Correspondingly the air gap 12 has a thickness of 8 to 20 mm, preferably equal to the thickness of the pane 10. the distance between the outer pane 10 and the laminated safety pane 14, however, never being less than two-thirds of the thickness of the outer pane 10, so as to have an adequate intermediate space for a 'free' disintegration of the piece of glass 40, which must cover a particular distance from the outer pane 10 as far as the individual pane 20 of the laminated safety pane 14.

In the embodiment illustrated in Figure 6 the energy of the projectile is of course cancelled out in the same manner as described hereinbefore, but it must be noted that when the laminated pane 14 bulges outwards the resulting splinters are kept off anybody inside the inner space by the splinter-catching pane 30. Instead of the splinter-catching pane 30, a splinter-catching film (not shown) can be glued on to the surface of the inner pane 16 remote from the film 24 (and thus from the pane 10), in the embodiment illustrated in Figures 1 - 5.

Experiments using projectiles have shown that glazing units of the kind shown in the drawings are secure against penetration by bullets when shot at from the left-hand side – i.e., from the side of the outer pane 10, whether from pistols or rifles, although of course the thickness of the individual panes will be adjusted accordingly. If for the same calibre of projectile a particular pane is used in such a manner that the shot comes from the side of the laminated safety pane 14, the bullet is observed to go right through the unit.

This effect, which is ascribed to the use of the monolithic thick glass outer pane 10, the adaption of the thickness of the gap 12 between the pane to the thickness of the outer pane, and the asymmetrical structure of the laminated safety pane 14, is completely surprising.

One advantage of the glazing unit according to the invention, which is secured against projectiles of course only from the direction of the outer pane. although it is so to a surprisingly high extent, is that for instance, an armed cashier might himself be able to fire out from a cash box protected by the glazing unit according to the invention, without being in any danger from shots from outside.

In the embodiment illustrated in Figure 7, the bullet-proof glazing unit has an outer composite pane which is disposed on the side from which the projectile might arrive and which includes a monolithic silicate glass pane 10 having a thickness of 6 to 20 mm. The outer pane 10 is adjoined on the side remote from the direction from which the bullet might come (in the drawings the bullet always comes from the left) by a laminated safety pane 14 spaced from the pane 14 by a gap 12, the width of the gap, measured perpendicular to the planes of the panes being at least two-thirds of the thickness of the outer pane 10, and preferably equal to the thickness thereof. The outer pane 10 and the laminated safety pane 14 are interconnected at the pane edges by means of a suitable edge section or the like in the manner known from double glazing units. In the embodiment illustrated the laminated safety pane 14 consists of three individual silicate glass panes. of which the inner pane 16 remote from the side from which the bullet might arrive has a thickness of 3 mm, the central individual pane 18 having a thickness of 4 mm, and the individual pane 20 adjacent the gap 12 between the panes having a thickness of 5 mm. The individual pane 20 is glued to the central

individual pane 18 by laminating film 22 of polyvinylbutyral, whose thickness in the embodiment illustrated is 0.76 mm, while the laminating film 24 connecting the inner pane 16 to the central individual pane 18 has a thickness of 1.14 mm. The laminated safety pane 14 is thus constructed asymmetrically. the thickness of the individual panes 20, 18, 16 of the laminated safety pane decreasing from the gap 12 between the pane 10 and 14 in the direction in which the bullet may come. the thickness of the laminating films 22. 24 increasing in the same direction. In addition to the pane construction described hereinbefore, as also carried out in the bullet-proof glazing units illustrated in Figures 1 -6. in the embodiment illustrated in Figure 7 the pane 10 has on the side thereof from which a projectile may arrive (on the left in the drawings) a very thin supporting pane 42 which in the embodiment illustrated consists of silicate glass of a thickness. for example. of between 1 and 4 mm and is glued to the monolithic pane 10 after the fashion of a laminated safety pane by a laminating film 44. The laminating film 44 can be made of a conventional material. for instance. a polyvinylbutyral film with a thickness less than .4 mm, e.g. of 0.38 mm or a corresponding PVC laminating film. Since unlike the laminating films 22. 24 of the rear laminated safety pane 14. the laminating film 28 is merely meant to glue the thin retaining pane 42. and is not intended to absorb the energy of a bullet. the thickness of film 44 may simply be that most convenient for manufacture and thus may. for example. be from 2 to 3 mm. The film 44 can if preferred be replaced by a layer of another adhesive substance. for instance. a pourable plastics substance. The supporting pane 42 can if preferred be made of plastics rather than glass. although this is not recommended on the outside of buildings since in that situation glazings with plastics are subject to heavy attack by weather The pane 42 is so firmly connected to the pane 10 that even if many bullets impinge on the glazing the supporting pane 42 firmly retains the remaining parts of the pane 10 i.e.. the parts not 'used up' by the breaking out of conical pieces of glass on the impingement of a projectile in the manner already described. that when further projectiles impinge such parts remain effective as required.

The embodiment illustrated in Figure 8 is a burglary-discouraging multi-pane glazing unit in which two laminated safety panes are provided separated by a gap 12 between the panes. One of these laminated safety panes. referenced 14. is disposed on the side of the gap 12 between the panes which is remote from the side from which a burglary may be attempted, consists of a silicate glass pane 20 having a thickness of 8 mm. a PVB layer 22 having a thickness of 4.3 mm. and a silicate glass pane 16 having a thickness of 2 mm. The other of these laminated safety panes, disposed on the opposite side of the gap 12 between the panes, consists of a silicate glass pane 10 having a thickness of 8 mm, a PVB layer 44 having a thickness of 2.5 mm and a silicate glass pane 42 having a thickness of 2 mm. By the use of the laminated safety pane on the side from which a burglary may be attempted this embodiment ensures a particularly effective protection against attack by tools, more particularly striking tools, used in burglaries.

In further embodiments not shown, in which. as in Figure 6, the laminated safety pane consists of two glass panes of different thickness which are interconnected by a plastics film, the last mentioned film has a thickness of from 1 to 5 mm, preferably from 3 to 5 mm. a thickness of from 4 to 5 mm being particularly preferred In these further embodiments. the individual glass pane of the laminated safety pane nearest the first pane (i.e. nearest the pane corresponding to pane 10 in Figures 1 to 7) preferably has a thickness of from 5 to 12 mm and the individual glass pane furthest from said first pane preferably has a thickness of from 2 to 3 mm.

WHAT WE CLAIM IS:—

1 A multi-pane anti-bandit glazing unit, having a first glass pane and a liminated safety pane which is substantially parallel with the first pane and is spaced therefrom in a direction perpendicular to said panes, the laminated safety pane comprising a plurality of individual glass panes adhesively bonded together by plastics laminating films and in which the first pane is 6 to 20 mm thick; the distance between the laminated safety pane and the first pane being at least two-thirds of the thickness of the first pane; the individual glass pane of the laminated safety pane nearest the first pane having a thickness of at least 5 mm, the thicknesses of successive individual glass panes of the laminated safety pane being progressively less in the direction away from the first pane and the thickness of at least one of the laminating films of the laminated safety pane being at least 1 mm.

2. A glazing unit according to Claim 1, wherein the thickness of the laminating films between the glass pane of the laminated safety pane which is furthest from said first pane and the adjoining glass pane of the safety pane is at least 1 mm.

3. A multi-pane glazing unit as set forth in Claim 1 or Claim 2 in which the thickness of the gap between the first pane and the laminated safety pane is substantially equal to the thickness of the first pane.

4. A multi-pane unit as set forth in any of Claims 1 to 3. in which at least the individual glass pane of the laminated safety pane nearest the first pane is a pane of silicate glass.

5. A multi-pane glazing unit as set forth in Claim 4, in which all the individual glass panes of the laminated safety pane are panes of silicate glass.

6. A multi-pane glazing unit as set forth in any preceding Claim, in which the laminated safety pane consists of two glass panes of different thickness which are inter-connected by a plastics laminating film having a thickness of from 1 to 5 mm.

7. A multi-pane glazing unit as set forth in Claim 6, in which the thickness of the laminating film is from 3 to 5 mm.

8. A multi-pane glazing unit as set forth in Claim 7, in which the thickness of the laminating film is 4 to 5 mm.

9. A multi-pane glazing unit as set forth in any of Claims 6 to 8, in which the individual glass pane of the laminated safety pane nearest the first pane is from 5 to 12 mm in thickness.

10. A multi-pane glazing unit as set forth in Claim 9, in which the individual glass pane of the laminated safety pane furthest from the first pane is from 2 to 3 mm in thickness.

11. A multi-pane glazing unit as set forth in any of Claims 1 to 4, in which the laminated safety pane has at least one plastics individual pane.

12. A multi-pane glazing unit as set forth in Claim 11, in which the thickness of the plastics individual pane of the laminated safety pane is 1 to 5 mm.

13. A multi-pane glazing unit as set forth in any of Claims 1 to 5, in which the laminated safety pane has at least three individual panes and the thickness of successive individual laminating films increases progressively in the direction away from said first pane.

14. A multi-pane glazing unit as set forth in Claim 13, in which the laminated safety pane has, in succession in the direction away from said first pane a silicate glass pane having a thickness of from 5 to 12 mm, a laminating film having a thickness of from 0.3 to 0.8 mm, a silicate glass pane having a thickness of from 4 to 6 mm, a laminating film having a thickness of from 0.1 to 1.2 mm and a silicate glass pane having a thickness of from 2 to 3 mm.

15. A multi-pane glazing unit as set forth in Claim 14, in which the laminated safety pane has, in succession in the direction away from said first pane a silicate glass pane which is 5 mm in thickness, a laminating film which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness and a silicate glass pane which is 3 mm in thickness.

16. A multi-pane glazing unit as set forth in Claim 14, in which the laminated safety pane has, in succession in the direction away from said first pane, a silicate glass pane which is 6 mm in thickness, a laminating film which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness, and a silicate glass pane which is 3 mm in thickness.

17. A multi-pane glazing unit as set forth in Claim 14, in which the laminated safety pane has, in succession in the direction away from said first pane a silicate glass pane which is 10 mm in thickness, a laminating film which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness and a silicate glass pane which is 2 mm in thickness.

18. A multi-pane glazing unit as set forth in Claim 14, in which the laminated safety pane has, in succession in the direction away from said first pane a silicate glass pane which is 8 mm in thickness, a laminating film which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness and a silicate glass pane which is 2 mm in thickness.

19. A multi-pane glazing unit as set forth in Claim 14, in which the laminated safety pane has, in succession in the direction away from said first pane a silicate glass pane which is from 10 to 12 mm in thickness, a laminating film which is 0.38 mm in thickness, a silicate glass pane which is 6 mm in thickness, a laminating film which is 0.76 mm in thickness, a silicate glass pane which is 4 mm in thickness, a laminating film which is 1.14 mm in thickness, and a silicate glass pane which is 2 mm in thickness.

20. A multi-pane glazing unit as set forth in any of Claims 1 to 19, in which the thickness of the first pane and of the gap between the first pane and the laminated safety pane is 10 mm.

21. A multi-pane glazing unit as set forth in any of Claims 1 to 19, in which the thickness of the first pane and of the gap between the first pane and the laminated safety pane is 8 mm.

22. A multi-pane glazing unit as set forth in any of Claims 1 to 19, in which the thickness of the first pane and of the gap between the first pane and the laminated safety pane is 20 mm.

23. A multi-pane glazing unit as set forth in any of Claims 1 to 19, in which the thickness of the first pane and of the gap between the first pane and the laminated glazing pane is 12 mm.

24. A multi-pane glazing unit as set forth in one of the preceding Claims, in which at least the individual pane of the laminated safety pane which is furthest from the first pane is made of chemically prestressed silicate glass.

25. A multi-pane unit as set forth in any of the preceding Claims, in which the laminating film or films of the laminated safety pane consists or consist of polyvinylbutyral.

26. A multi-pane glazing unit as set forth in any of the preceding Claims, in which the first pane or the laminated safety pane is provided with an alarm device.

27. A multi-pane glazing unit as set forth in any of the preceding Claims, in which a splinter-catching pane is disposed at a distance from the laminated safety pane on the side of the laminated safety pane remote from the first pane, the last-mentioned distance being such as to enable the laminated safety pane to bulge if hit by a bullet.

28. A multi-pane glazing unit as set forth in Claim 27, in which the splinter-catching pane takes the form of a further laminated safety pane.

29. A multi-pane glazing unit as set forth in Claim 28, in which the splinter-catching pane consists of two silicate glass panes glued to one another by a plastics laminating film.

30. A multi-pane glazing unit as set forth in Claim 29, in which at least one of the silicate glass panes of the splinter-catching pane is chemically hardened.

31. A multi-pane glazing unit as set forth in any of Claims 1 to 26, including a splinter-catching film which is glued on to the outer surface, remote from the first pane of the individual pane of the laminated safety pane which is remote from the first pane.

32. A multi-pane glazing unit as set forth in any of the preceding Claims, in which a plastics film is disposed on the side of the first pane remote from the laminated safety pane.

33. A multi-pane glazing unit as set forth in any of the preceding Claims, in which the first pane has a heat-reflecting coating on its side adjacent the laminated safety pane.

34. A multi-pane glazing unit as set forth in any of Claims 1 to 32 in which said first pane is a composite pane comprising a supporting pane providing the outer surface of the first pane remote from the laminated safety pane, and further comprising a further pane to which the supporting pane is adhesively bonded by a plastics film, said supporting pane having a thickness of no more than 4 mm.

35. A multi-pane glazing unit as set forth in Claim 34, in which the thickness of the supporting pane is 1.5 to 3 mm.

36. A multi-pane glazing unit as set forth in Claim 34 or 35, in which the supporting pane consists of silicate glass.

37. A multi-pane glazing unit as set forth in Claim 34 or 35, in which the supporting pane consists of plastics.

38. A multi-pane glazing unit as set forth in any of Claims 33 to 37, in which the thickness of the plastics film between the supporting pane and said further pane to which the supporting pane is bonded is 2 to 3 mm.

39. A multi-pane glazing unit as set forth in any of Claims 34 to 38, in which the thickness of the plastics film between the supporting pane and said further pane to which the supporting pane is bonded is less than 0.4 mm.

40. A multi-pane glazing unit as set forth in any of Claims 36 to 39, in which the plastics film between the supporting pane and said further pane to which the supporting pane is bonded consists of polyvinylbutyral.

41. A multi-pane glazing unit as set forth in any of Claims 34 to 39, in which the plastics film between the supporting pane and said further pane to which the supporting pane is bonded consists of PVC.

42 A multi-pane glazing unit as set forth in any of Claims 34 to 41, in which the plastics film bonding the supporting pane to said further pane is formed by a pourable plastics substance.

43. A multi-pane glazing unit as set forth in any of claims 34 to 42, wherein said further pane is a monolithic glass pane.

44. A multi-pane glazing unit as set forth in any of Claims 1 to 32, in which the first pane is a monolithic glass pane, or consists of a monolithic glass pane with a heat reflecting coating on its side adjacent the laminated safety pane.

45. A multi-pane glazing unit as set forth in Claim 44, in which the monolithic glass pane consists of silicate glass.

46. A multi-pane glazing unit as set forth in Claim 45, in which the first pane is the outside pane of the multi-pane unit which receives any possible violence, more particularly a bullet.

47. A multi-pane glazing unit as set forth in Claim 44, in which the thickness of the first pane and the gap between the first pane and the laminated safety pane is 6 mm in each case.

48. A multi-pane glazing unit substantially as hereinbefore described with reference to and as shown in Figure 1 of the accompanying drawings.

49. A multi-pane glazing unit substantially as hereinbefore described with reference to and as shown in Figure 6 of the accompanying drawings.

50. A multi-pane glazing unit substantially as hereinbefore described with reference to and as shown in Figure 7 of the accompanyin drawings.

51. A multi-pane glazing unit substantially as hereinbefore described with reference to and as shown in Figure 8 of the accompanying drawings.

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Fig.1

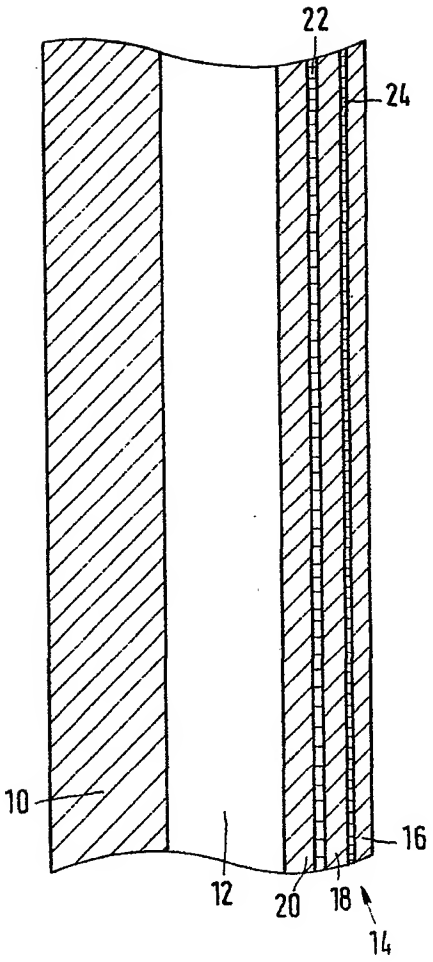

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Fig.2

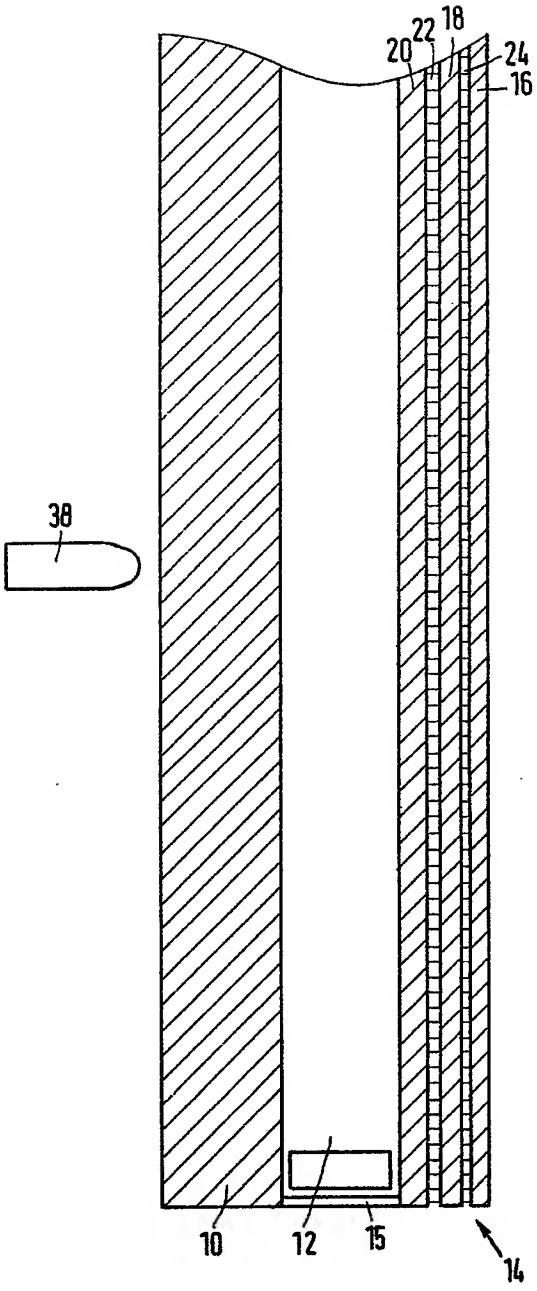

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Fig.3

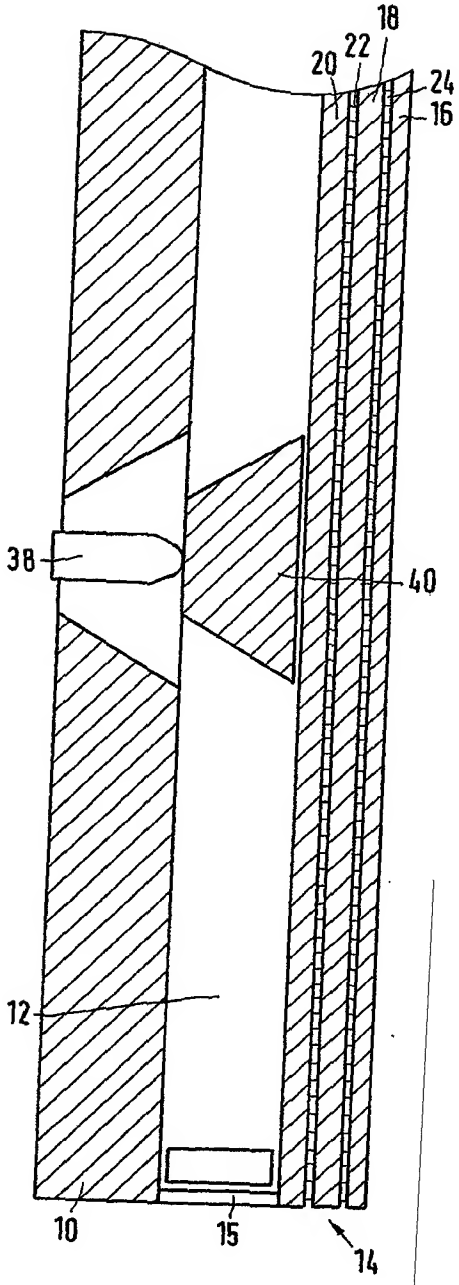

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Fig.4

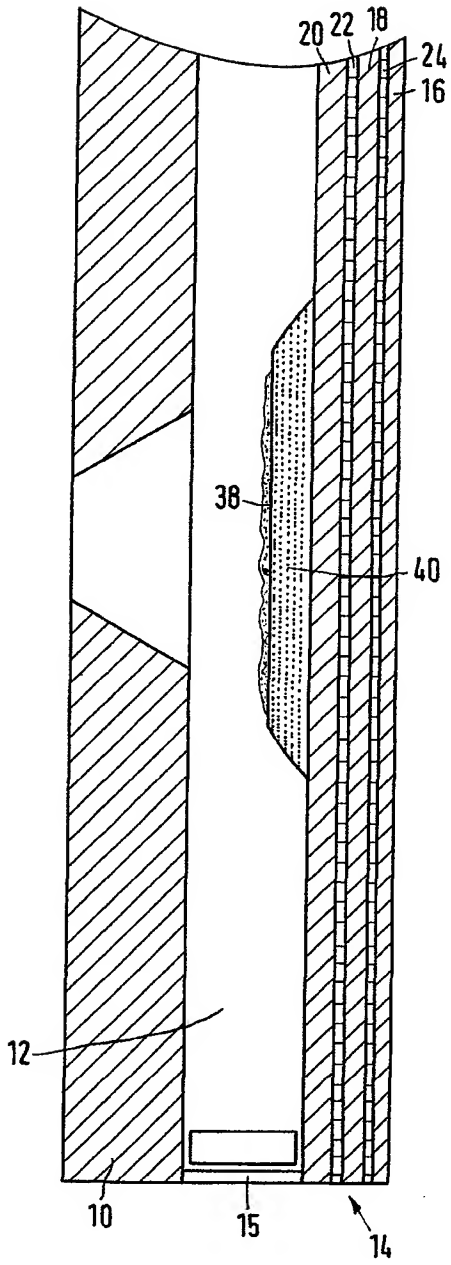

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Fig.5

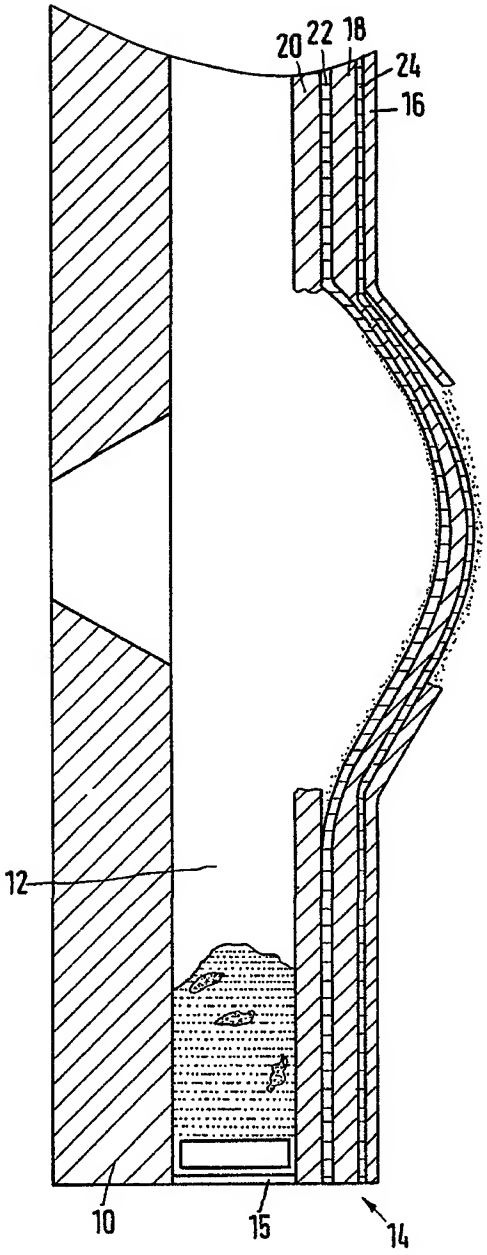

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Fig.6

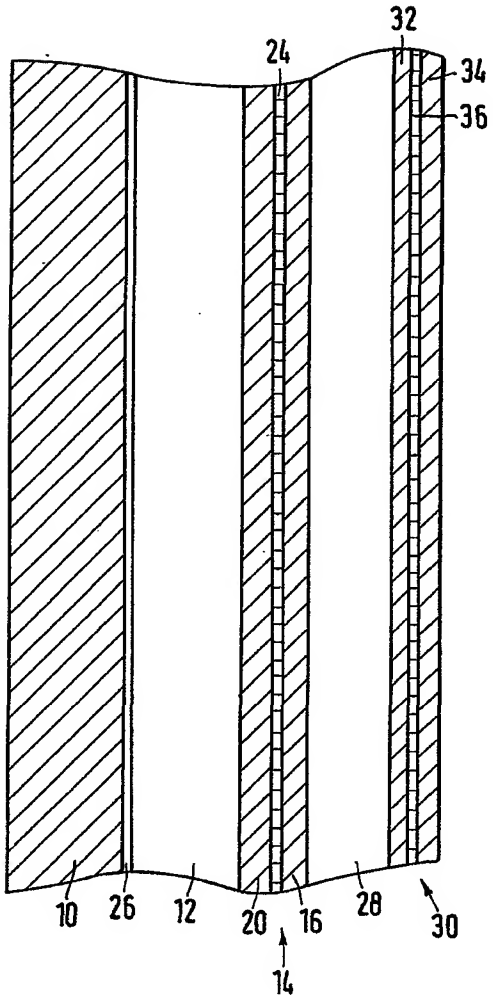

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Fig.7

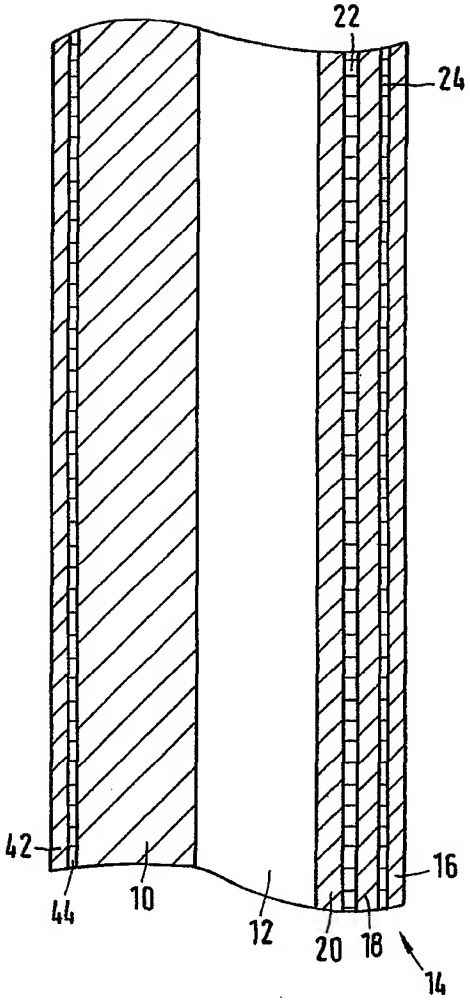

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Fig.8